

# (12) UK Patent Application (19) GB (11) 2 338 832 (13) A

(43) Date of A Publication 29.12.1999

(21) Application No 9813686.4

(22) Date of Filing 25.06.1998

(71) Applicant(s)  
**NEC Technologies (UK) Ltd**  
(Incorporated in the United Kingdom)  
Castle Farm Campus, Priorslee, TELFORD, Shropshire,  
TF2 9SA, United Kingdom

(72) Inventor(s)  
**Paul Leslie Spicer**

(74) Agent and/or Address for Service  
**John Orchard & Co**  
Staple Inn Buildings North, High Holborn, LONDON,  
WC1V 7PZ, United Kingdom

(51) INT CL<sup>6</sup>  
H01H 13/70 , H04M 1/03 , H05K 1/11

(52) UK CL (Edition Q )  
H1N N8G N54X N637 N649 N654 N704 N854  
H2E EEKD EHC E163

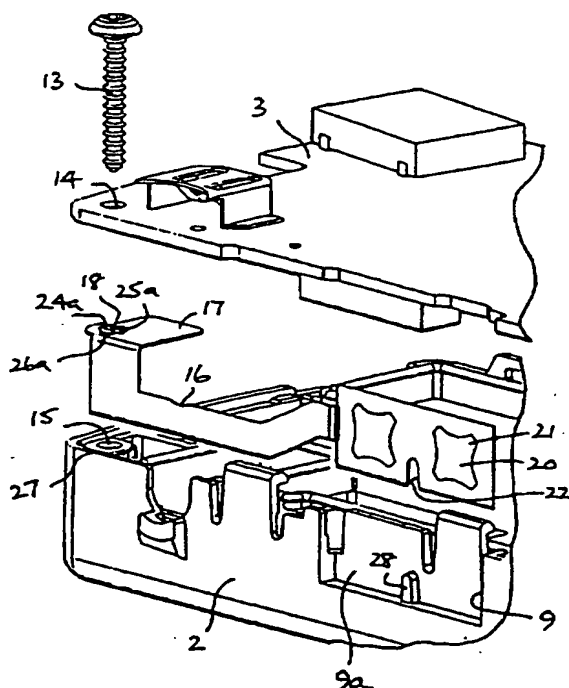
(56) Documents Cited  
US 5357065 A

(58) Field of Search  
UK CL (Edition P ) H1N NAX N8G NUT  
INT CL<sup>6</sup> H01H 13/70  
Online: WPI

(54) Abstract Title  
**Volume control switch for mobile phone**

(57) A mobile phone handset comprises a casing (2), a PCB (3) with volume control circuitry thereon mounted on the casing and a flexible strip (16) with conductive paths thereon connecting the PCB 3 with a volume control switch (20). Each electrically conductive path has a break in it which is located beneath the deformable volume control switch (20) so that when the switch is depressed, it deforms a metal part thereof and bridges the break in the electrical paths to complete the electrical circuit. The other end of each path terminates in a contact pad (24a,25a,26a) which may be formed around an aperture 18. The PCB 3 also has electrically conductive paths on it which terminate in contact pads on its undersurface. The PCB (3) is fixed on the casing (2) by retaining means such as a screw (13) which compress the electrically conductive contact pads on the PCB (3) and the flexible member (16) together to make an electrical connection therebetween and fix the PCB 3 on the casing 2.

FIG. 2



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

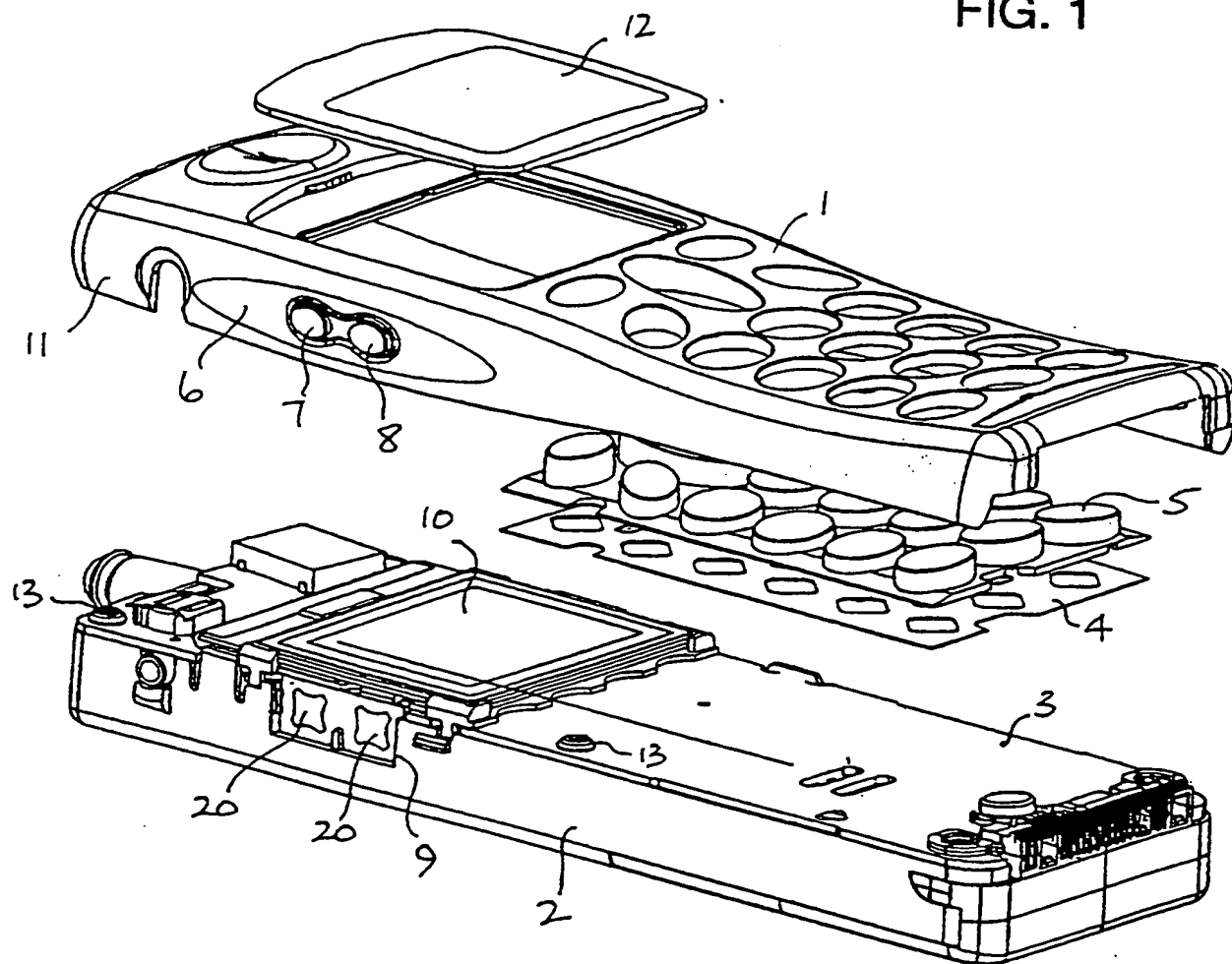


FIG. 2

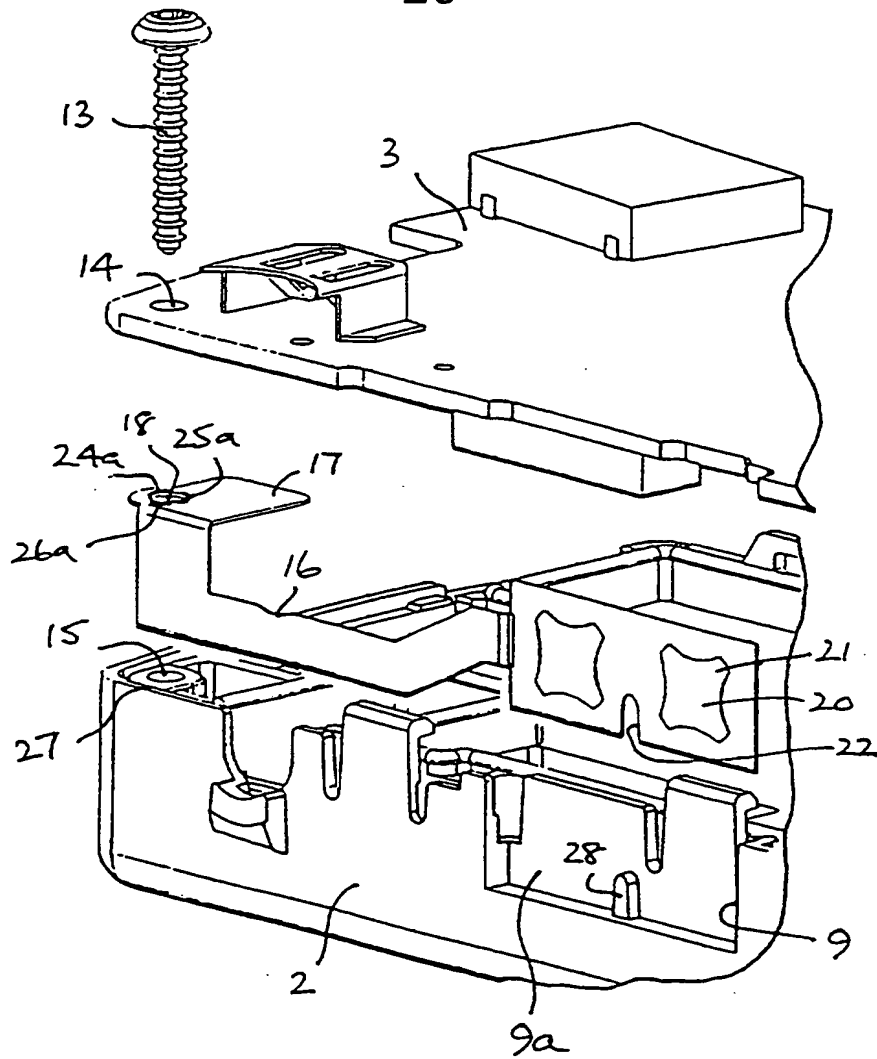


FIG. 5

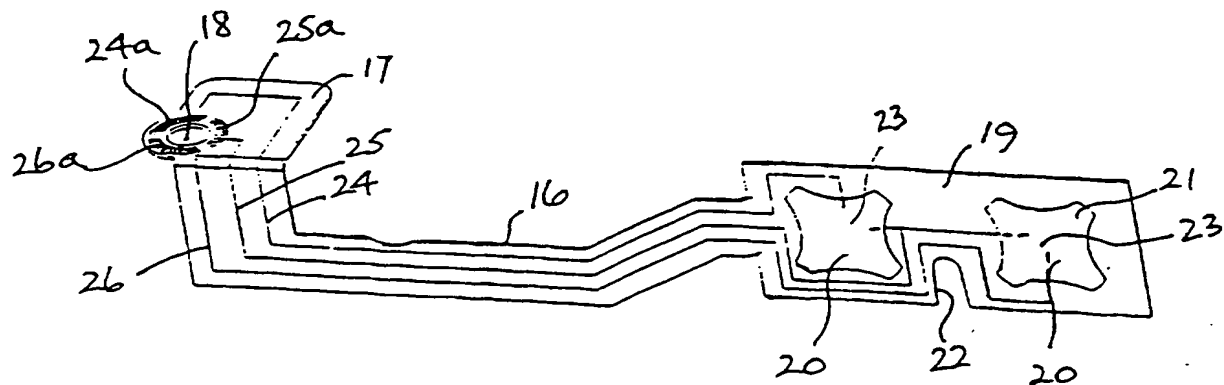


FIG. 3

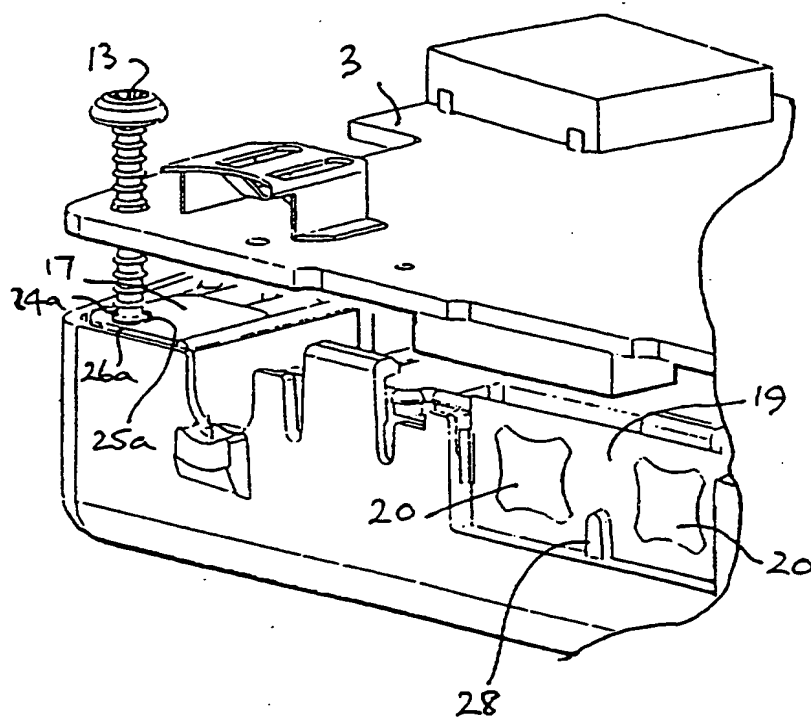
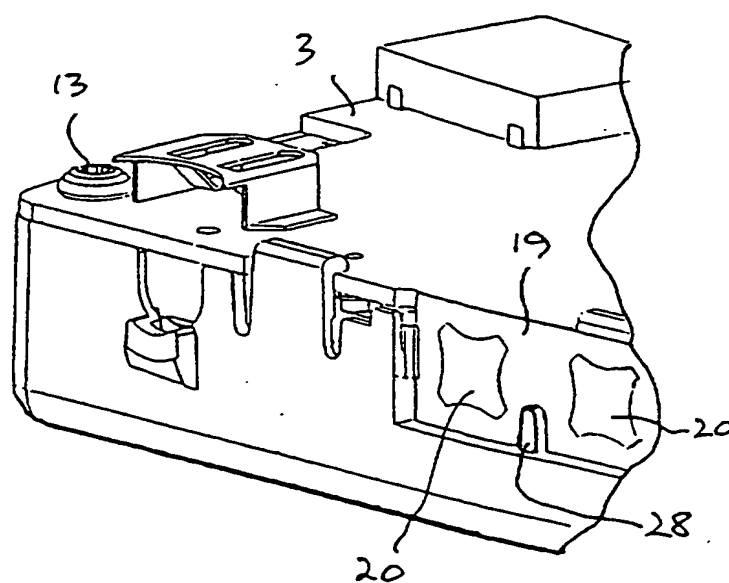


FIG. 4



## MOBILE PHONE HANDSET

This invention relates to a mobile phone handset and more particularly to a novel volume switch assembly therefor.

5

There are many ways that a volume switch can be provided on a handheld portable phone but most of them are costly and space consuming as they require either mechanical switches or connectors to be surface mounted on the printed circuit board (PCB) for the telephone.

10 When designing a small handheld portable phone whose capacity is less than 100cc, the use of such large and costly components needs to be kept as low as possible as does the bill of materials (BoM).

It is an object of the present invention therefore to provide a small  
15 handheld portable phone with a volume switch assembly which is cost effective, uses space to the maximum and requires no surface mounted components (SMC's).

According to one aspect of the invention, there is provided a mobile  
20 phone handset comprising a casing, a PCB with volume control circuitry thereon mounted on said casing, a flexible strip with conductive paths thereon connecting said PCB with a deformable volume control switch, each electrically conductive path having a break therein located beneath said deformable volume control switch whereby, when the switch is  
25 depressed, it deforms and a metal part thereof bridges the break in the electrical paths to complete the electrical circuit, the other end of each of

said paths terminating in a contact area, the PCB having electrically conductive paths thereon which also terminate in a contact area and the PCB being fixed to the casing by retaining means which compress the electrically conductive contact areas on the PCB and flexible member together to make an electrical connection therebetween and fix the PCB on the casing.

Preferably each contact area is an enlarged pad conveniently in the form of an arcuate strip which is wider than the conductive path connected thereto.

The conductive paths are preferably printed on the flexible strip using a conductive ink enhanced with silver.

Preferably the flexible strip has an aperture therein around which the contact areas are circumferentially arranged, the flexible strip comprising a base layer with said conductive paths thereon, a spacer layer and a covering layer.

In the preferred embodiment, the switch member is made wholly of metal with a dome-shaped portion which deforms when depressed whereby the undersurface contacts the electrically conductive paths on the base layer to bridge the break therebetween.

Conveniently the dome shaped portion has a corner foot formed thereon which is sandwiched between the base layer and the spacer layer to

mount the switch on the flexible strip, the spacer layer having an aperture therein to receive the dome-shaped portion of the switch.

5 Preferably the strip has two volume control switches mounted on it, the casing comprising a front and back part, and the flexible strip being mounted vertically in a sidewall of the casing which has a cut out portion therein to permit exterior access to the volume switches mounted on the strip.

10 The aperture in the flexible strip is preferably formed in a tab at one end thereof, said tab being folded over at 90° to the remainder of the strip to position the aperture over a mounting hole in the casing to receive the retaining means which conveniently can be a retaining screw.

15 According to another aspect of the invention there is provided a switch assembly for fitting to a mobile phone handset comprising a flexible strip with electrically conductive paths thereon, each of which has a break therein and a contact area arranged around an aperture, at least one deformable switch member mounted on the strip and arranged so that  
20 when the switch is depressed and deformed, a metal portion thereof on its underside is brought into contact with the conductive paths to bridge a break therein to complete the electrical circuit.

The invention will now be described, by way of example only, with  
25 reference to the accompanying drawings, in which:

Figure 1 is an exploded view of a mobile phone handset incorporating the novel volume switch assembly of the present invention;

Figure 2 is an exploded perspective view of one end of the handset shown in Figure 1 prior to the insertion of the switch assembly therefor;

5 Figure 3 is a view similar to Figure 2 but with the volume switch assembly inserted in the handset casing;

Figure 4 is a further view of Figure 3 with the volume switch fully assembled in the casing; and

10 Figure 5 is a perspective view of the volume switch assembly shown in Figures 1-4 prior to insertion in the casing.

Referring to the drawings, there is shown in Figure 1 an exploded view of a mobile phone handset of the present invention which comprises a casing made up from a front casing part 1 and a back casing part 2. A  
15 printed circuit board (PCB) 3 is mounted on the back casing part 2 by means of retaining screws 13 which pass through a hole 14 (see Figures 2-4) in the PCB and are received in tapped hole 15 in the rear casing part 2. As shown in Figure 1, the phone also includes a keypad 4 and a keypad membrane 5 and an LCD display screen 10 protected by a transparent  
20 cover or window 12. None of these components form part of the present invention and therefore they will not be described further here as they are well known in the art.

A volume switch 6 is mounted on the side wall or skirt of the front cover  
25 1 and includes a pair of buttons 7 and 8. The front cover has a skirt portion 11 around its periphery which receives the periphery of the back



casing part 2, the skirt overlying the side wall of the casing part 2. The front cover 1 is retained on the back cover 2 by integral clips and a pair of screws not shown.

5 When the front cover 1 is assembled on the back part 2, the sidewalls of the front cover 11 overlie the sidewall of the back cover 2 and the switches 7 and 8 are positioned above metal dome-shaped switch members 20 and operate in a manner to be described later.

10 Referring now to Figure 5, it can be seen that the volume switch assembly comprises a flexible strip 16 having electrically conductive paths 24, 25 and 26 printed thereon in known manner. A tab 17 is provided at one end and has a hole 18 formed therein. The end of each conductive path 24, 25 and 26 is formed into an arcuate electrically conductive area  
15 or pad 24a, 25a, 26a arranged circumferentially around the hole 18.

A pair of switches 20 made entirely of metal or having a dome-shaped metal central portion are mounted on the flexible strip 16 by means of corner tabs 21 which are pushed through the strip and folded over on the  
20 reverse side. The electrically conductive paths 24, 25 and 26 extend along the flexible strip 16 breaks or gaps 23 are provided therein in the region behind and beneath the switches 20. It will be appreciated therefore that when the switches 20 are depressed and deformed, the central metal curved portion thereof will be deflected towards the conductive paths 24,  
25 25 and 26 and will bridge the break 23 therein when contact is made with them to complete the electrically conductive path.

Referring now to Figure 2, the switch assembly just described with reference to Figure 5 is shown just prior to insertion into the sidewall of the rear casing part 2. The sidewall of the casing part 2 has a cut-out portion 9 therein with an upstanding rear wall 9a and a nib 28 formed at the base thereof for reasons which will be described shortly. As can be seen from Figure 2, the flexible strip is lowered into a space in the sidewall of the casing part 2 until the cut-out 22 in the bottom edge of the larger end section 19 locates on the nib 28 to position said enlarged end section 19 vertically in the cut-out portion 9 against the rear wall 9a. The flexible strip 16 continues along the rear face of the sidewall of the casing part 2 and locates in a space 27 (see Figure 2) between the sidewall 2 and screw hole 15 in the casing which receives retaining screw 13.

15 The end tab 17 having hole 18 therein extends at 90° to the remainder of the flexible strip 16 and is folded over the tapped hole 15 so that the conductive pads 24a, 25a and 26a thereon are positioned around it.

In order to complete the assembly of the volume switch in the handset, the screw 13 can now be screwed into the tapped hole 15 to draw the PCB 3 downwardly onto the rear casing part 2. Although not visible in the drawings, the underside of the PCB 3 also has electrically conductive paths thereon which terminate in pads (not shown) corresponding to the pads 24a, 25a and 26a on the flexible strip 16. As a result, when the PCB 13 is screwed down onto the casing 2 by means of the screw 13, the pads on the under surface of the PCB 3 will make electrical contact with the

pads 24a, 25a and 26a on the flexible strip to electrically connect the PCB 3 with the switches 20.

5 The switching assembly of the present invention utilises existing space in the handset normally required for retaining screws and eliminates the need to use mechanical switches or conventional connectivity to the main PCB hence saving space and cost. The preferred embodiment uses a polyester flexible circuit of a three layer construction with metal domes as the up/down switches which are tracked to three pads positioned  
10 around the circumference of an aperture to clear the retaining screw.

## Claims

1. A mobile phone comprising a casing, a PCB with volume control circuitry thereon mounted on said casing, a flexible strip with conductive paths thereon connecting said PCB with a volume control switch, each electrically conductive path having a break therein located beneath said deformable volume control switch whereby, when the switch is depressed, it deforms and a metal part thereof bridges the break in the electrical paths to complete the electrical circuit, the other end of each of said paths terminating in a contact area, the PCB having electrically conductive paths thereon which also terminate in a contact area on its undersurface, the PCB being fixed on the casing by retaining means which compress the electrically conductive contact areas on the PCB and the flexible member together to make an electrical connection therebetween and fix the PCB on the casing.
2. A mobile phone as claimed in claim 1 wherein each conductive path terminates in an enlarged pad area to provide a contact pad.
3. A mobile phone as claimed in claim 1 or claim 2 wherein each conductive path is printed on the flexible strip using a conductive ink.
4. A mobile phone as claimed in any of claims 1 to 3 wherein each conductive path is made of a silver loaded material.

5. A mobile phone as claimed in any of claims 2-4 wherein each pad is arcuate in shape and wider than the conductive path.

6. A mobile phone as claimed in any of claims 2-5 wherein the flexible strip has an aperture therein around which the pads are circumferentially arranged.

7. A mobile phone as claimed in any preceding claim wherein the flexible strip comprises a base layer with said conductive paths thereon, a spacer layer and a covering layer.

8. A mobile phone as claimed in claim 7 wherein the switch member is metal and has a dome-shaped central portion which deforms when depressed whereby the underside thereof contacts the electrically conductive paths on the base layer to bridge the break therein and complete the electrical circuit.

9. A mobile phone as claimed in claim 8 wherein each dome-shaped portion has corner feet formed thereon by means of which the dome-shaped switch member is attached to the flexible strip.

10. A mobile phone as claimed in claim 9 wherein the corner feet are sandwiched between the base layer and the spacer layer, the spacer layer having an aperture therein in the region beneath the dome-shaped portion to receive the dome-shaped portion.

11. A mobile phone as claimed in any preceding claim wherein two volume control switches are mounted on the strip.
12. A mobile phone as claimed in any preceding claim wherein the casing comprises a front part and a back part, the flexible strip being mounted vertically in a sidewall of the back part which has a cut-out section therein to permit exterior access to the volume switches mounted thereon.
13. A mobile phone as claimed in claim 6 wherein the aperture is formed in a tab provided at one end of the flexible strip which is folded over at 90° to the remainder of the strip to position the aperture over a mounting hole in the casing which receives the retaining means.
14. A mobile phone as claimed in any preceding claim wherein the retaining means is a screw.
15. A switch assembly for fitting to a mobile phone handset comprising a flexible strip with electrically conductive paths thereon each of which has a break therein and terminates in a contact area arranged around an aperture, at least one metal deformable switch member mounted on the strip and arranged so that when the switch member is depressed and deformed, a metal portion thereof on its underside is brought into contact with conductive paths to bridge the break therein and complete the electrical circuit.

16. A mobile phone handset substantially as herein described with reference to the accompanying drawings.

17. A switch assembly for fitting to a mobile phone handset substantially as herein described with reference to the accompanying drawings.



Application No: GB 9813686.4  
Claims searched: 1-14 & 16

Examiner: Steven McIlroy  
Date of search: 21 October 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P): H1N NAX, NBG, NUT

Int CI (Ed.6): H01H 13/70

Other: Online: WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	US 5357065 (Fujitsu Limited) See whole document, especially figure 3 showing portion 20a with (apparent) volume control switches #22, #23 and terminals 58 joining flexible sheet 20 to PCB 18.	1, 2, 7, 8, 11 & 12

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.